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Technical Report No. 1

Assessment of Perceptual, Decoding, and Lexical Skills and Their Relation to Reading Proficiency

John R. Frederiksen

January 1978

Prepared for:
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The goal of this research ~~is~~ seeks to develop and validate techniques for measuring perceptual and cognitive skills ~~that are~~ related to reading proficiency. Studies ~~are described representing~~ examine three domains: the perceptual, decoding and lexical stages of processing.

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To study differences among readers in decoding skills, (he ~~we~~ selected an oral reading or pronunciation task. Readers differ in both the accuracy and efficiency with which they decode English spelling patterns, particularly when the patterns to be decoded are unfamiliar. A comparison of the effects of structural variations among words and pseudowords on decoding times led us to conclude that low ability readers rely on holistic properties of words -- presumably their visual characteristics -- in recognizing common words. High ability readers tend instead to use their well-developed decoding skills in recognizing words, whether they are common or uncommon.

At the lexical level, we explored the effects of visual familiarity on times for identifying words and pseudowords, using a lexical decision task. The results suggest that decoding proceeds more slowly when the stimulus item is visually unfamiliar. While low ability readers were more susceptible to the effects of visual familiarity, they did not differ from high ability readers in times for lexical access and retrieval.

Report No. 3756 Bolt Beranek and Newman Inc.

Assessment of Perceptual, Decoding, and Lexical Skills and their Relation to Reading Proficiency

John R. Frederiksen

Technical Report No. 1

January 1978

This research was sponsored by the Personnel and Training Research Programs, Psychological Sciences Division, Office of Naval Research, under Contract No. N00014-76-C-0461, Contract Authority Identification Number NR 154-386. This paper was presented at the NATO International Conference on Cognitive Psychology and Instruction in Amsterdam, the Netherlands, June 1977.

SUMMARY

The goal of this research is to develop and validate techniques for measuring perceptual and cognitive skills that are related to reading proficiency. Studies are described representing three domains: the perceptual, decoding and lexical stages of processing.

At the perceptual level, we were concerned with visual scanning and the encoding of graphemic and supragraphemic units. Using a letter identification task, we found that subjects who were low in overall reading ability scan a visual image more slowly than do readers of high ability, and they are slower in identifying letters when they do not occur in a familiar sequence. Readers generally are able to exploit the sequential and positional redundancies characteristic of English orthography.

To study differences among readers in decoding skills, we selected an oral reading or pronunciation task. Readers differ in both the accuracy and efficiency with which they decode English spelling patterns, particularly when the patterns to be decoded are unfamiliar. A comparison of the effects of structural variations among words and pseudowords on decoding times led us to conclude that low ability readers rely on holistic properties of words -- presumably their visual characteristics -- in recognizing common words. High ability readers tend instead to use their well-developed decoding skills in recognizing words, whether they are common or uncommon.

At the lexical level, we explored the effects of visual familiarity on times for identifying words and pseudowords, using a lexical decision task. The results suggest that decoding proceeds more slowly when the stimulus item is visually unfamiliar. While low ability readers were more susceptible to the effects of visual familiarity, they did not differ from high ability readers in times for lexical access and retrieval.

ACKNOWLEDGMENTS

This research was sponsored by ONR Contract N00014-76-C-0461. The support and encouragement of Marshall Farr and Henry Halff, and of Joseph L. Young are gratefully acknowledged. I would like to thank Marilyn Adams and Richard Pew for fruitful discussions during many phases of the work, and Barbara Freeman and Jessica Kurzon, who implemented the experimental design.

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ASSESSMENT OF PERCEPTUAL, DECODING, AND LEXICAL SKILLS AND THEIR RELATION TO READING PROFICIENCY

I. INTRODUCTION

A central problem in evaluation research is the assessment of effects of instructional strategies on specific information-processing skills. The goal of the research project on which I shall report is to develop and validate techniques for measuring perceptual and cognitive skills that are related to reading proficiency, and to investigate how deficiencies in particular skills may limit an individual's ability to read with speed and comprehension. The measures to be developed are chosen to represent five skill domains or levels of processing as illustrated in Figure 1:

1. The Perceptual Level includes processes involved in the encoding of visual information, scanning a visual image, pattern recognition, encoding of graphemic or supragraphemic units, and storing the order of encoded visual units.

2. The Decoding Level includes skills involved in the translation of English orthographic patterns into derived phonemic patterns.

3. The Lexical Level includes skills involved in utilizing available evidence for accessing the lexicon, in retrieving

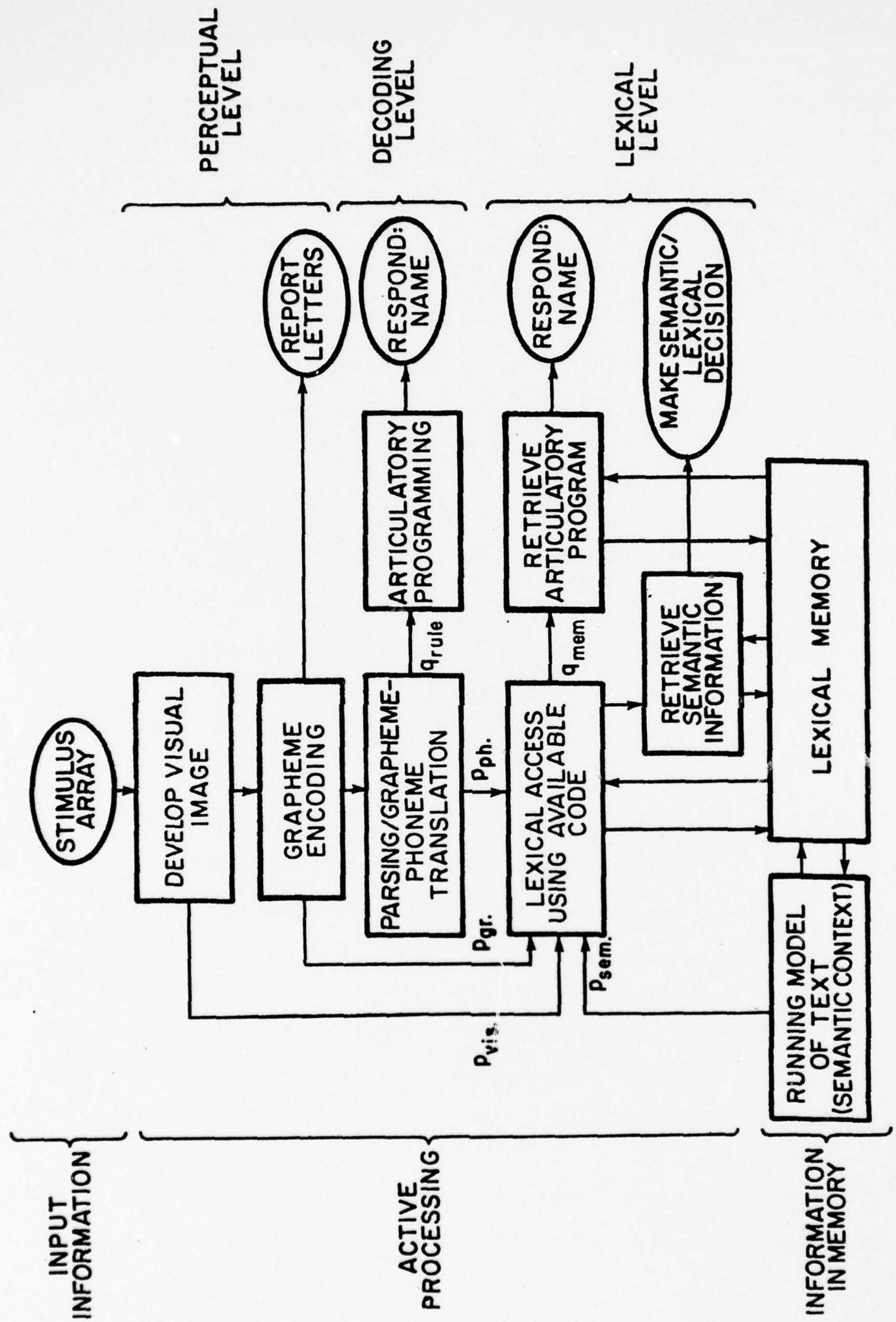

Fig. 1. The general conceptual model underlying the experiments.

lexical information of either a semantic or articulatory nature, and in making semantic and lexical decisions on the basis of retrieved information.

4. The Phrasal Level includes skills involved in the use of propositional and syntactic structure to guide lexical search and retrieval, the construction of a running model of text, and the use of contextual information in making lexical identifications and semantic decisions.

5. Interactions among processes occuring at different levels constitute a fifth domain of interest. To take one example, the presence of phrase level constraints on a lexical item can influence the mode of lexical access and the use of decoding processes in lexical retrieval. Such interactions can be expected to contribute to a fluent, integrated approach to reading.

I shall review a set of experiments we have carried out which are aimed at the measurement of processing strategies and levels of processing accuracy and efficiency in a number of these domains. The following general approach has been taken: On the basis of pertinent existing theory, experimental tasks are chosen for each domain and variables selected that allow us to manipulate the degree to which the relevant processing skill contributes to task performance. Validation of the experimental

procedures is based upon the correspondence between theoretical predictions and experimental results, and on their relationship to an external measure of reading ability. Contrasts among the experimental conditions are then defined which (1) represent selected processing skills within the domain under investigation, and (2) are related to an individual's level of reading ability. Individual subject's scores on these contrasts serve as measures of processing skill.

II. EXPERIMENTAL STUDIES

The Perceptual Domain

Method and Subjects. In order to measure skills in the perceptual domain, a letter identification task was selected. Subjects were asked to report all of the letters they could identify in a masked, briefly-presented stimulus array. While a third of the stimulus items were four-letter English words, the remaining items were English-like four-letter arrays in which two letters were masked during the exposure so that only a single pair of adjacent letters was available for the subject to report. The critical (unmasked) letters were either the first 2 letters (e.g., KN--), the middle 2 letters (e.g., -NC-), or the final 2 letters (e.g., --RD). In addition to varying in their location, the critical bigrams were chosen to represent two sources of redundancy in English orthography: (1) redundancy due to sequential constraints which occur among letters, and (2) redundancy due to positional constraints on letter occurrence. Accordingly, the critical bigrams varied (1) in the overall frequency with which the letters occur together in English prose (e.g., TH [high], GA [middle], and LK [low]), and (2) in their likelihood of occurring in their presented position in a normal, four-letter English word (e.g., TH-- [high] vs. -TH- [low]).[1]

[1]Bigrams were selected on the basis of frequencies of occurrence and positional likelihoods in four-letter words as

To make the task perceptually demanding, the stimulus array was preceded and followed by a 300 msec. masking field, and the stimulus duration chosen was the shortest duration that would still allow 95% of the stimulus letters to be correctly reported (generally 90-100 msec.). Finally, in order to relate performance to reading skill, the twenty subjects (high school students) were divided into 4 levels (quartiles) on the basis of Nelson-Denny reading test scores.

Results and Discussion. We found that our subjects were sensitive to the manipulations of sequential and spatial redundancy; bigrams having low, middle, and high probabilities of occurrence were reported correctly 88%, 92%, and 93% of the time, respectively, while bigrams occurring in unlikely and likely locations were reported correctly 90% and 92% of the time. These differences, while small in magnitude, were highly reliable ($p<.001$ and $p<.005$, respectively) and suggest that letters within an orthographically regular array are not processed independently, and that positional cues can facilitate encoding.

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recorded in the Mayzner and Tresselt (1965) tables. Twelve bigrams were selected for each combination of location (positions 1 and 2, 2 and 3, and 3 and 4), bigram probability (low, middle, and high), and positional likelihood (low and high). There were no significant differences among these groups of bigrams in (a) the product of the probabilities of the individual letters, or (b) the product of the positional likelihoods of the individual letters.

In addition to these general results, we found that subjects who vary in reading ability differ reliably both in their rate of scanning a perceptual array, and in their sensitivity to redundancy built into the stimulus. In Figure 2, we have plotted mean identification latencies for bigrams occurring in each of three positions within a 4-letter array for subjects at each ability level. While overall letter identification latencies are longer only for the poorest group of readers, the slopes of the array-length functions decrease as reading ability increases. The high rate of scanning obtained with high ability readers (250 letters/sec.) is five times that obtained with the poorest readers (48 letters/sec.), and suggests that the strongest readers may be processing letters in parallel.

The interaction between bigram frequency and reading ability is illustrated in Figure 3. The magnitude of the bigram effect decreases as reading ability increases. While high ability readers are capable of efficiently processing letters that occur together in English over a broad frequency band, low ability readers' efficiency in processing is limited to letter pairs that typically occur together, with high frequency.

For all subjects, the effect of bigram probability is most marked when the critical pair of letters is presented in the first 2 positions, and appears to decrease as the position of the letter pair is moved from left to right within the array (see

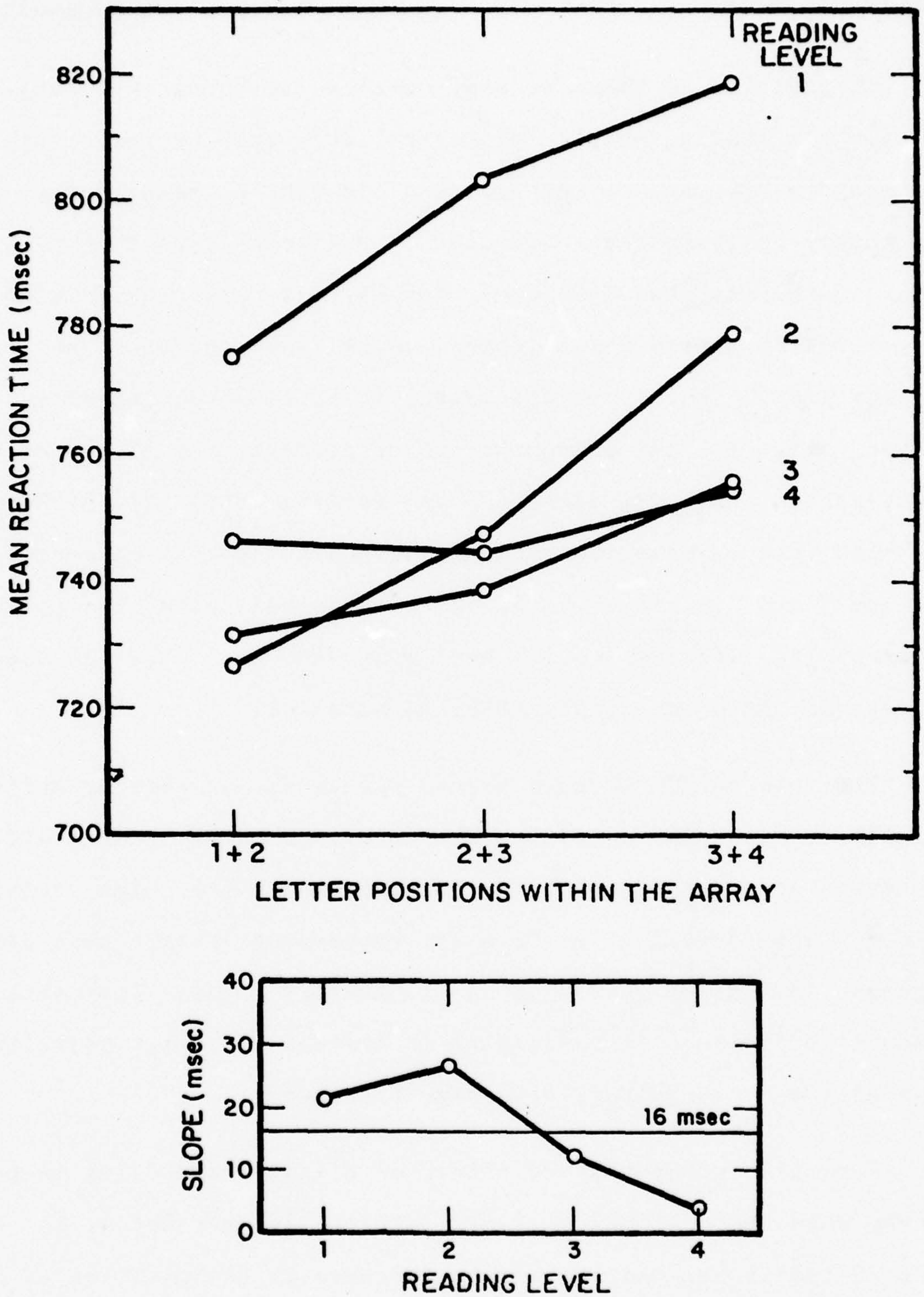

Fig. 2 Mean reaction times in letter identification plotted as a function of bigram location and reading level. The slopes of fitted lines are plotted at the bottom of the figure for each reading level.

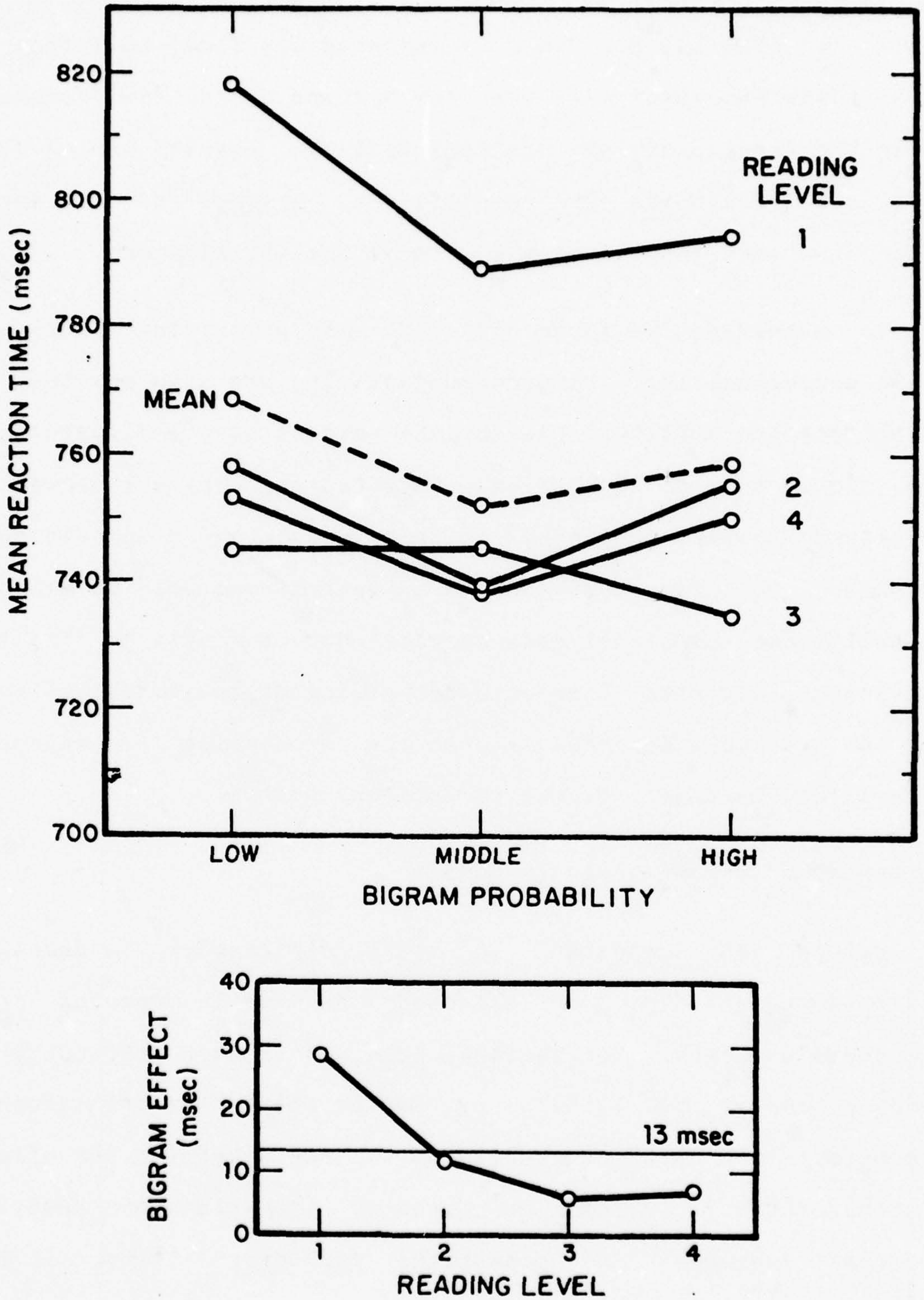

Fig. 3 Mean reaction times in letter identification, plotted as a function of bigram probability and reading level. The size of the bigram effect (mean for low frequency bigrams minus the mean for middle and high frequency bigrams) is plotted at the bottom of the figure for each reading level.

Figure 4). Finally, positional redundancy was found to influence letter identifications only when the bigrams are of low frequnecy and in the first position. In that instance, bigrams having high positional likelihoods were identified an average of 14 msec. faster than were those having low positional likelihoods.

To summarize, we found differences in processing efficiency at the perceptual level between subjects who are high or low in overall reading ability. Low ability readers scan a visual array more slowly than do high ability readers, and they are slower in identifying letters when they do not occur in a predictable sequence. The fact that readers in general are able to exploit sequential and positional redundancies characteristic of English orthography suggests that the processing of individual letters does not proceed independently from the processing of adjacent letters (cf. Landauer, Didner, & Fowlkes, Note 1).

The Decoding or Word-Analysis Domain

Method and Subjects. To study differences in decoding skills among readers, we selected an oral reading (or pronunciation) task. Our strategy here was to vary difficulty in decoding arrays of letters by manipulating the orthographic structure of our stimulus materials. We can determine the effect of orthographic variations on decoding latencies by studying subjects' responses in pronouncing pseudoword items. If the

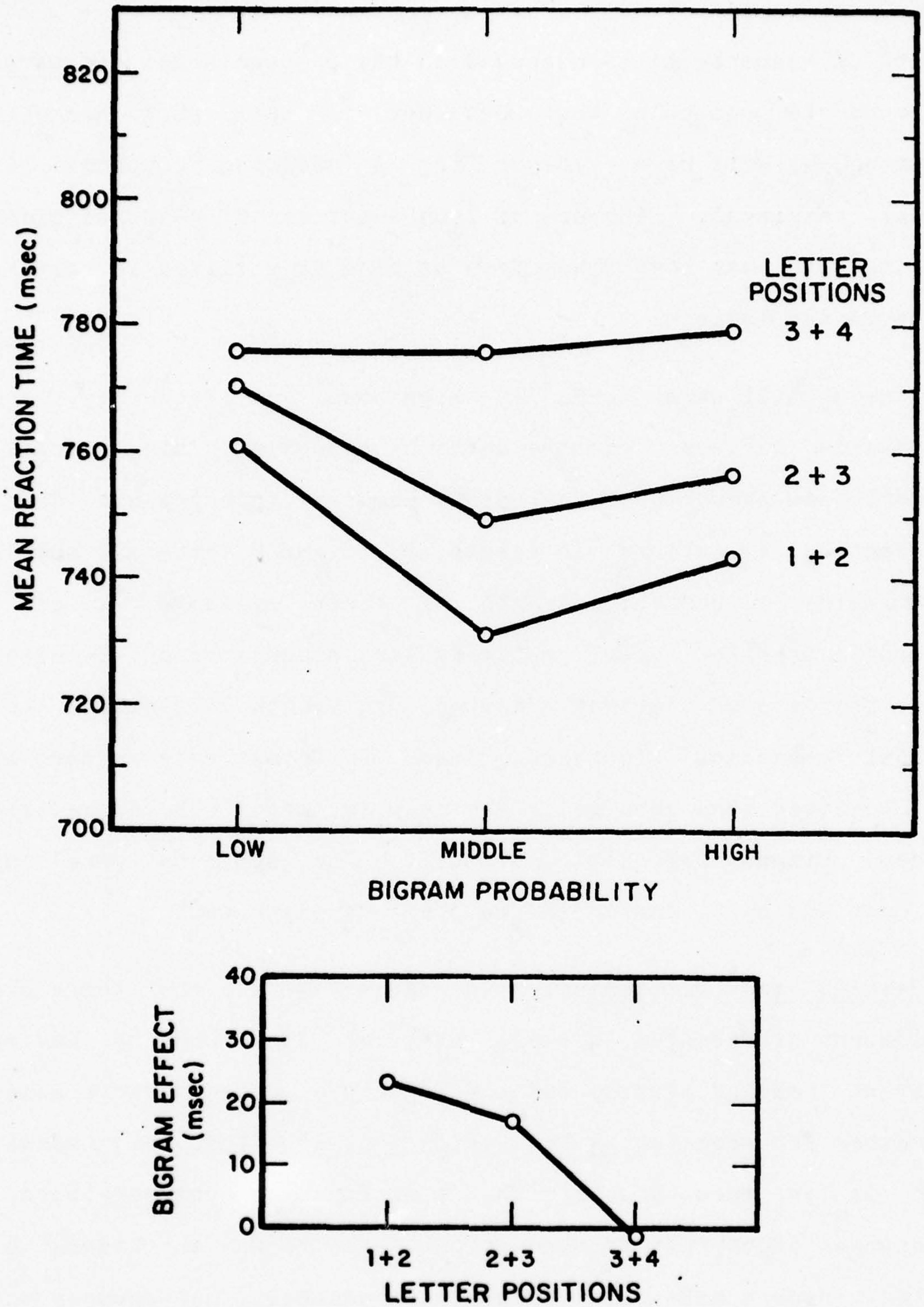

Fig. 4. Mean reaction times in letter identification, plotted as a function of bigram location and bigram probability. The size of the bigram effect is plotted at the bottom of the figure for each location.

pattern of response times observed in the pronunciation of words is found to resemble that obtained in this pure decoding situation, we will have evidence for a decoding component in lexical retrieval. Absence of such a pattern of response times will indicate that some other form of code is utilized in gaining access to the lexicon.

The stimuli were words of high and low frequency, and pseudowords derived from the words by changiing a single vowel. The words and pseudowords include 22 separate orthographic forms representing variations in length (4, 5, and 6 letters), number of syllables (1 and 2), length of first syllable (2 or 3 letters), type of vowel (primary or secondary; cf. Venezky, 1970), presence of a silent-e marker, and length of initial and terminal consonant clusters. These 22 forms were matched on initial letter (and phoneme). The stimulus array was exposed for 50 msec. without any masking stimuli. The subjects were the same ones who participated in the previous experiment.

Results and Discussion. In Figure 5 we see that there are significant differences in onset latencies for subjects having different reading levels, and the magnitude of these differences is greater for pseudowords than it is for low frequency words, which is in turn greater than that for high frequency words. Percentages of correct pronunciations are shown in Figure 6. Skilled readers make fewer errors in pronouncing pseudowords and

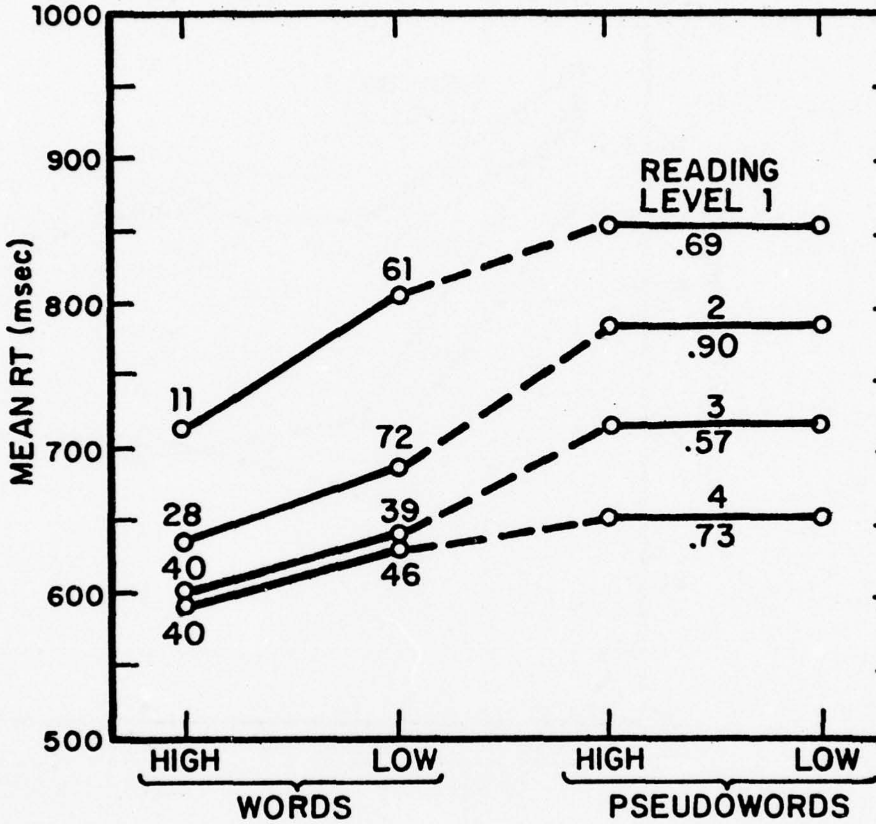

Fig. 5 Mean onset latencies obtained in the pronunciation experiment for high and low frequency words and pseudowords, plotted separately for subjects at four reading levels.

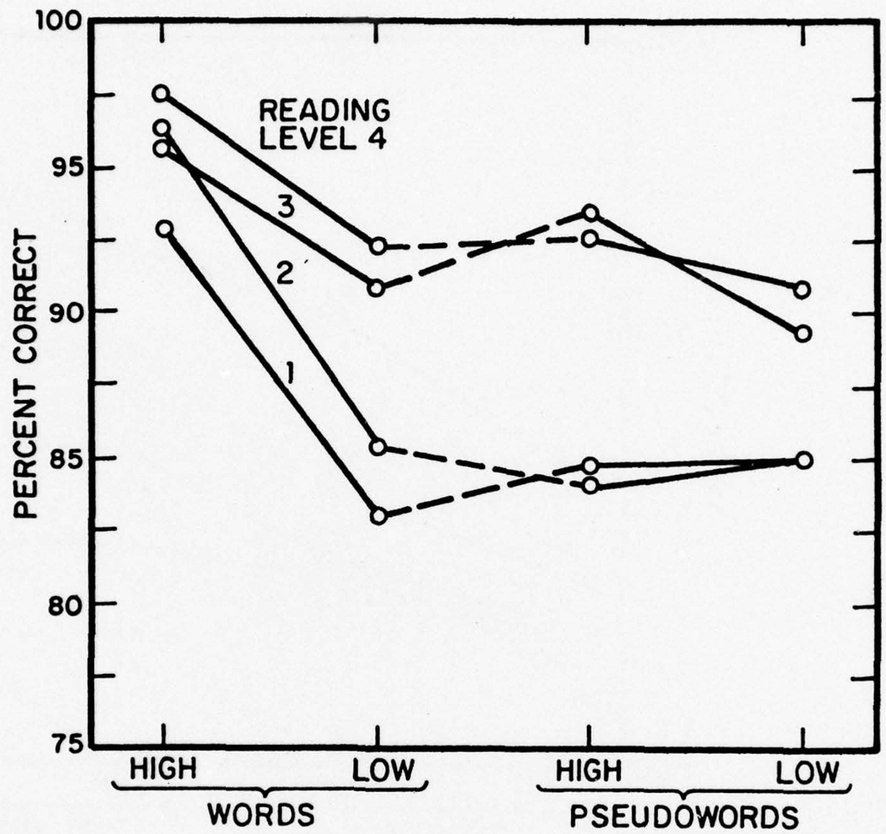

Fig. 6 Percentage of correct responses obtained in the pronunciation experiment for high and low frequency words and pseudowords, plotted separately for subjects at four reading levels.

low frequency words than do less skilled readers, but these differences in accuracy of pronunciation are not present when the stimuli are common words. In summary, readers appear to differ in both the accuracy and efficiency with which they decode English spelling patterns, and the differences in performance for high and low ability readers are most marked when the letter patterns to be decoded are unfamiliar.

Turning to the effects of variations in orthographic structure, within each of the classes of stimuli (words and pseudowords of high and low frequency), 22 separate orthographic forms were represented. Restricting our attention for the moment to <u>pseudoword</u> decoding, we find that the differences in mean onset latencies across these 22 forms are reliable, the average reliability across the four groups of readers being .72 (for levels One to Four, respectively: .69, .90, .57, and .73). Next, we can compare the effects of orthographic variables on mean onst latencies for words with those for pseudowords by computing the correlations (calculated over the 22 forms) between mean onset latencies for pronouncing high and low frequency words with those for pseudowords. These correlations, expressed as percentages of the reliable variance in pseudoword decoding times, are also given in Figure 5. For poor readers, latencies for naming high frequency words are not predictable from pseudoword decoding times (11% and 28%), while latencies for naming low frequency

words are closely related (61% and 72%) to those obtained for pseudowords having similar orthographic forms. However, in the case of high ability readers, latenciees for naming words are predictable to the same degree for both high and low frequency words. For low ability readers, the identificaiion of low frequency words utilizes word-analysis (decoding) skills similar to those that are required in pronouncing pseudowords, but the recognition of high-frequency words relies on more holistic properties of words -- presumably their visual characteristics, as Perfetti and Hogaboam (1975) have suggested. High ability readers, on the other hand, are efficient decoders and tend to employ those highly-developed skills in the recognition of high as well as low frequency words.

A detailed analysis of the effects of particular orthographic variables on word recognition latencies is shown in Figure 7. Here are shown the results of planned comparisons among orthographic forms, which yielded significant effects in the decoding of pseudoword items. Onset latencies are longer for items having longer initial consonant clusters. They are longer for pseudowords and low frequency words having secondary vowels (e.g., SAID) than for those having primary vowels (e.g., SONG), and these differences are larger for poor readers than for good readers. Onset latencies for 2-syllable items exceed those for 1-syllable items, and these effects are greater for poor readers

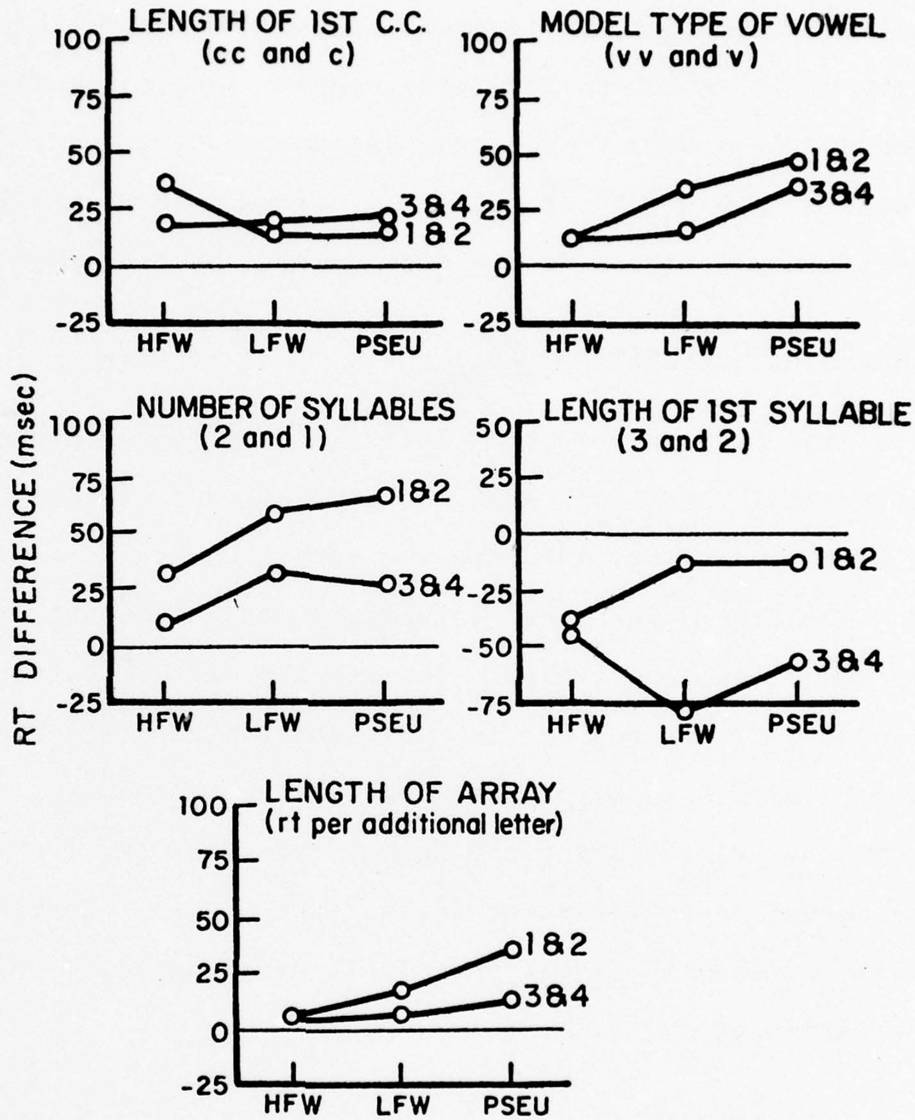

Fig. 7 Differences in onset latencies for the planned comparisons among orthographic forms as a function of stimulus type (high frequency words, low frequency words, and pseudowords). Separate plots are given for readers at the top two and bottom two levels.

than for good readers. The syllable effects appear to be larger when the initial syllable is two letters long than when it has 3 letters. Finally, the increase in response time for each added letter is greater for poor readers than for good readers, and depends upon word frequency. Together, these results show that readers of varying ability differ substantially in their efficiency in decoding the more complex orthographic forms.

The Lexical Domain

The purpose of the lexical decision experiment was to investigate methods used for decoding and lexical access during silent reading, by subjects who vary in overall reading ability. In addition, we were interested in evaluating the effects of manipulating the visual familiarity of a letter array on subjects' performance in decoding and lexical retrieval. This was accomplished by altering the letter cases used in presenting stimulus words and pseudowords. Visually familiar stimuli were presented in a consistent letter case (e.g., WORDS or words), while visually unfamiliar stimuli were presented using a mixture of letter cases (e.g., WoRd).

The effects of case mixing on times for lexical decisions can be anticipated on the basis of an analysis of decoding presented in Figure 8. When stimuli are presented in a consistent case, multiletter units can be directly identified,

Decoding under Two Levels of Perceptual Encoding

Process	Perceptual Encoding	
	Single-Letter Units	Multi-Letter Units
Stimulus	SHOOTING	SHOOTING
Encoded Visual Units	S/H/O/O/T/I/N/G	SH/OO/T/ING
Decoding: Parsing Grapheme Array	SH/OO/T/ING	
Decoding: Phonemic Translation	ʃutɪŋ	ʃutɪŋ
Assignment of Stress and Intonation	ʃut'ɪŋ	ʃut'ɪŋ

Fig. 8 Hypothetical processing stages in decoding under single case and mixed case conditions.

leading to a simplification in the decoding process. Presenting items in mixed cases decreases the size of visually-encodeable units, and increases decoding demands, since decoding must begin with a larger number of initial units. Mixing letter cases should therefore increase the magnitude of array-length effects, which are attributable to letter encoding and processes of decoding; however mixing of letter cases should not lead to an increase in size of syllable effects, since syllabication is thought to take place after decoding of the letter array.[2] We expect the effects of letter mixing to be greater for poor readers than for good readers, since any increase in the demands placed upon decoding skills will have a particularly strong impact on readers who are poor decoders.

The effects of mixing letter cases on word frequency effects should be minimal for high ability readers, since for these readers the coded phonemic representation accurately portrays the stimulus item which furnishes the basis for lexical retrieval. For poor readers, however, the picture is expected to be different. Poor readers are not only deficient in decoding skills; they tend to employ visual strategies for word recognition when a word is familiar to them. The effect of case mixing is simultaneously to eliminate the possibility of using a visual recognition strategy and to increase the difficulty of

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[2] Note that other theorists (e.g., Spoehr and Smith, 1973) have favored a theory of syllabication prior to decoding.

successful decoding, and thus obtaining an accurate phonemic representation of the stimulus. Since poor readers must base their lexical decisions on an imperfect representation of the stimulus, they can be expected to require additional time for lexical retrieval.

Method and Subjects. The stimulus items included in the experiment were words and pseudowords varying in length (4,5, and 6 letters), syllabic structure (1 and 2 syllables), and frequency class (four equal logarithmic frequency intevals). The subject's task was to judge whether an item was a word or pseudoword, and to respond by depressing an appropriate response key. One group of subjects was presented with items in a consistent letter case while a second group was presented the items using a mixture of letter cases. There were 16 subjects in each treatment group, with 4 subjects representing each level of reading ability.

Results and Discussion. Reaction time changes obtained as a result of case mixing are shown in Figure 9. There was an increase in magnitude of array-length effects from an average of 17 msec. in the single-case condition[3] to an average of 66 msec. in the mixed-case condition. The interaction between visual familiarity (single vs. mixed case presentation) and array

[3] In this and subsequent analyses reported, distinctions between upper and lower single-case presentations are ignored. In a prior analysis of variance of single case data, no significant effects of case were observed.

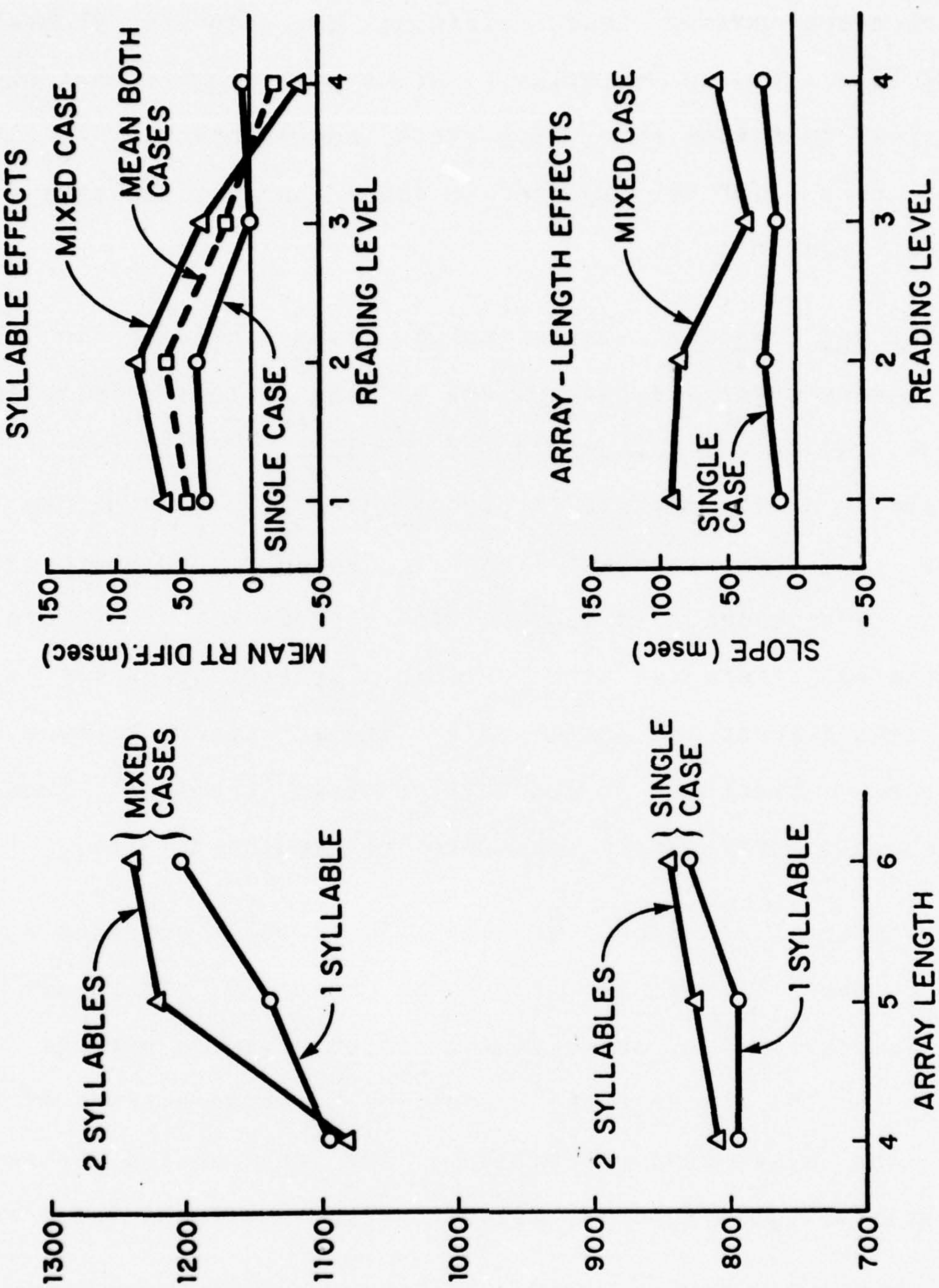

Fig. 9 Mean response latencies for single and mixed case stimulus presentation obtained in the lexical decision experiment. On the left, mean latencies are shown for words and pseudowords varying in length and number of syllables. On the right, the magnitude of syllable effects (difference between 2 and 1 syllable items) and of array-length effects (slopes) are shown for readers at each of 4 ability levels.

length was significant at the .005 level. At the same time, there was no significant interaction between syllabic length and visual familiarity ($F[1,24] = .46$, $p = .50$), although the main effect of syllabic length was significant ($p<.05$). Two-syllable items required an average of 27 msec. longer to process than did one-syllable items. The magnitudes of array-length and syllable effects under each mode of stimulus presentation are shown at the right of Figure 9 for subjects at each reading level. Several trends are apparent: First, the effect of case mixing on slopes of array-length functions is greater for low ability readers than for high ability readers. Second, syllable effects disappear in the case of high ability readers but are present in the case of low ability readers.

The effects of case mixing on mean response latencies for words in each frequency class are shown in Figure 10. There are no significant differences among subjects at the four reading levels when the single case mode of presentation is employed. However, when visually unfamiliar stimuli are used, we find an increase in the height and slope of the reaction time functions. The overall mean response latencies for words and pseudowords presented in single and mixed case modes are shown in Figure 11, for subjects at each reading level. Mean reaction times for the poorest group of readers jumped from 866 msec. in the single case condition to 1281 msec. in the mixed case condition when words

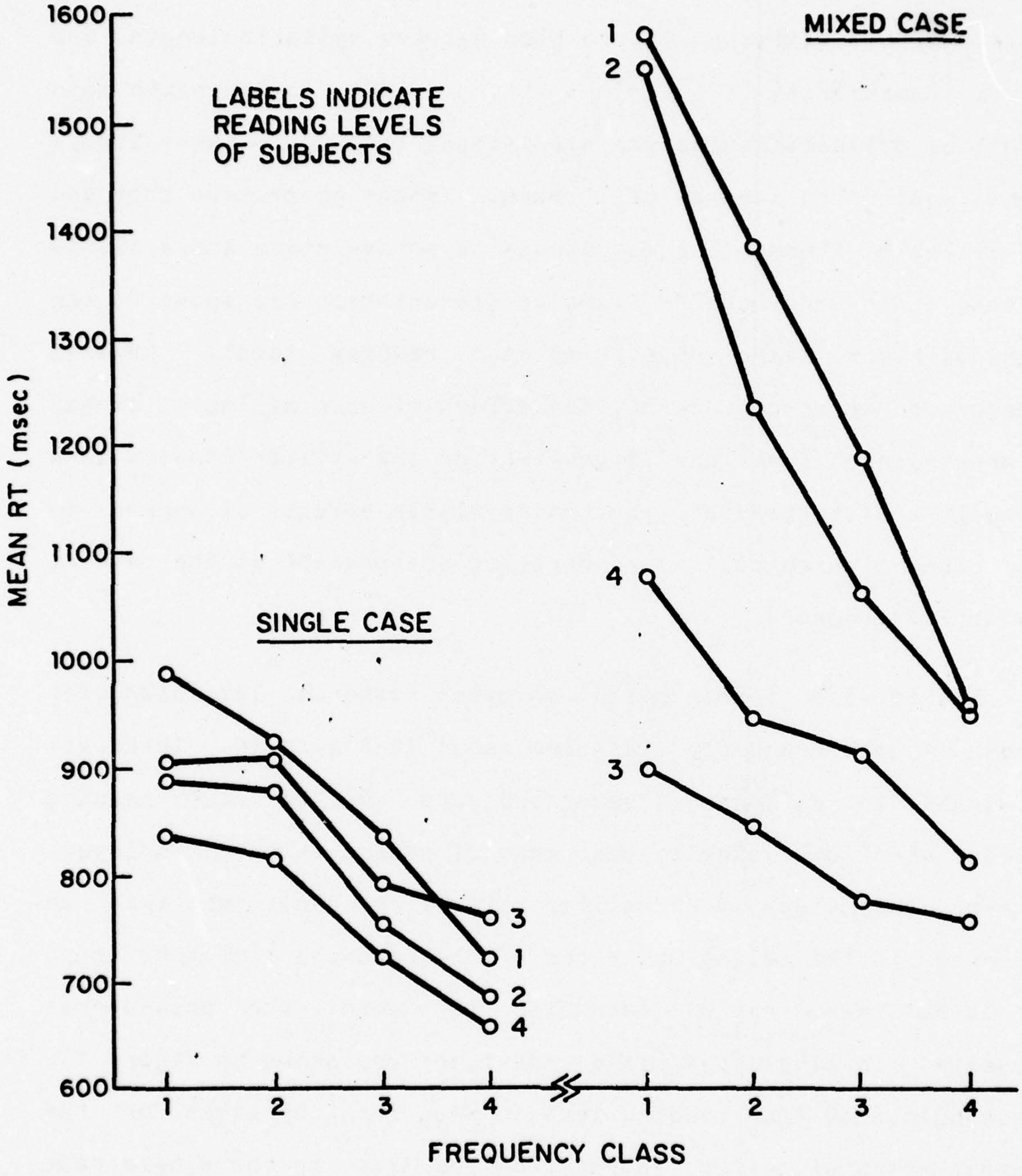

Fig. 10 Mean lexical decision latencies are shown for words belonging to four frequency classes, presented under single case and mixed case conditions. Data are plotted separately for subjects at each reading level. The frequency classes represent the following intervals: 1 = 1/M (Million) or fewer, 2 = 2/M to 5/M, 3 = 6/M to 29/M, and 4 = 30/M or greater.

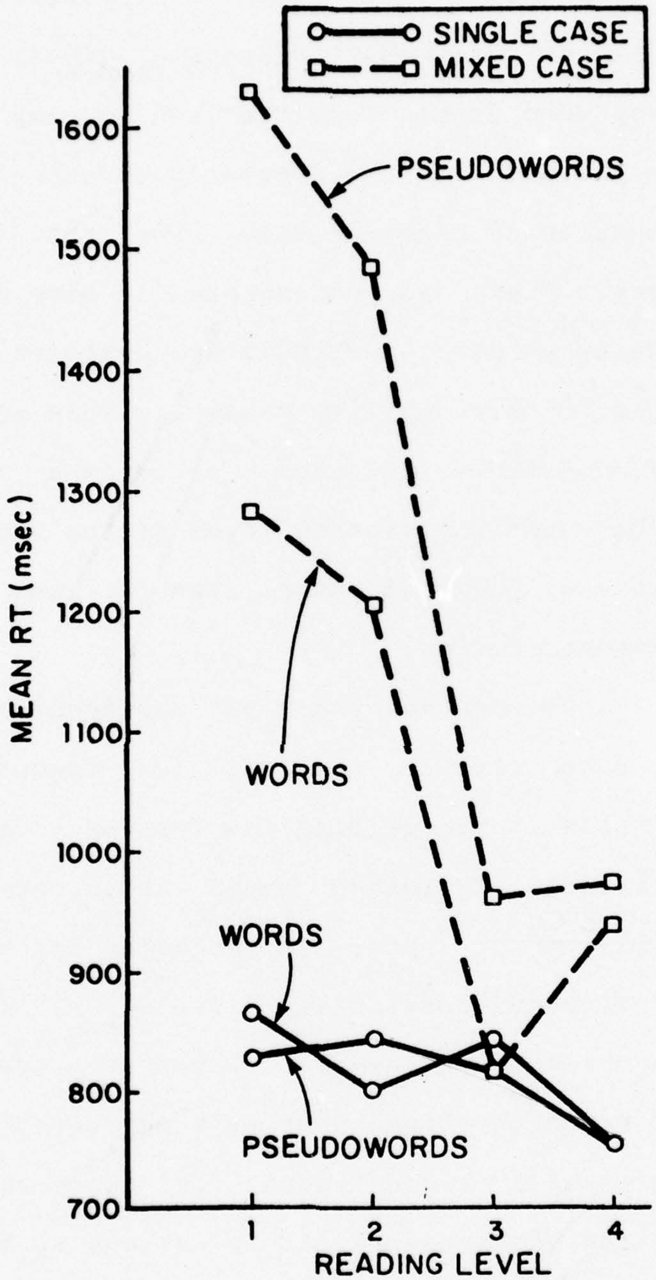

Fig. 11 Overall mean lexical decision latencies for words and pseudowords presented under single and mixed case conditions, plotted as a function of the subjects' reading level.

were judged, and from 831 msec. to 1629 msec. when pseudowords were judged. However, only small effects of visual familiarity on response latency were found for the two strong groups of readers. The magnitude of the frequency effect is plotted in Figure 12 as a function of reading level. For the two poorest groups of readers, there is an increase in size of frequency effects when visually unfamiliar stimuli are employed. No such increase is found for high ability readers. This suggests that the adequacy of a phonemic translation, as a cue for lexical retrieval, depends upon the reading level of the subjects. The types of errors made by good and poor readers lend additional support to this interpretation.

In Figure 13, we see that the major source of errors was a failure of subjects to correctly identify low frequency words. While the error rates in recognizing low frequency words are not affected by the mixing of letter cases to produce visually unfamiliar stimuli, error rates in decoding and categorizing pseudowords are influenced substantially by visual familiarity. There were more errors when the pseudowords were presented in a mixture of letter cases then when they were presented in a single letter case. The overall error rates for poor readers were higher than those for good readers. This was due to two sources: Poor readers were less able to recognize low frequency words than were good readers (39% correct compared with 58% correct), and were less able to accurately decode linguistically regular

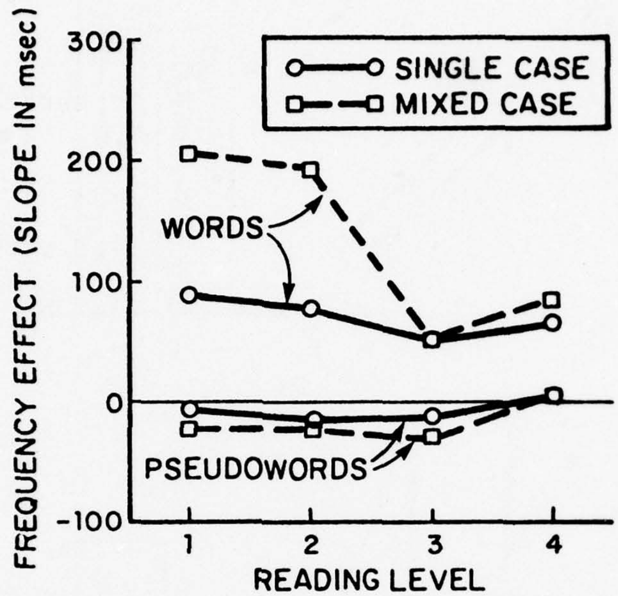

Fig. 12 Magnitude of the word frequency effect obtained with words and pseudowords, using single and mixed case modes of presentation. The ordinate values are magnitudes of negative fitted slopes, and represent decreases in reaction time for unit increases in frequency class. Frequency effects are plotted as a function of subjects' reading ability.

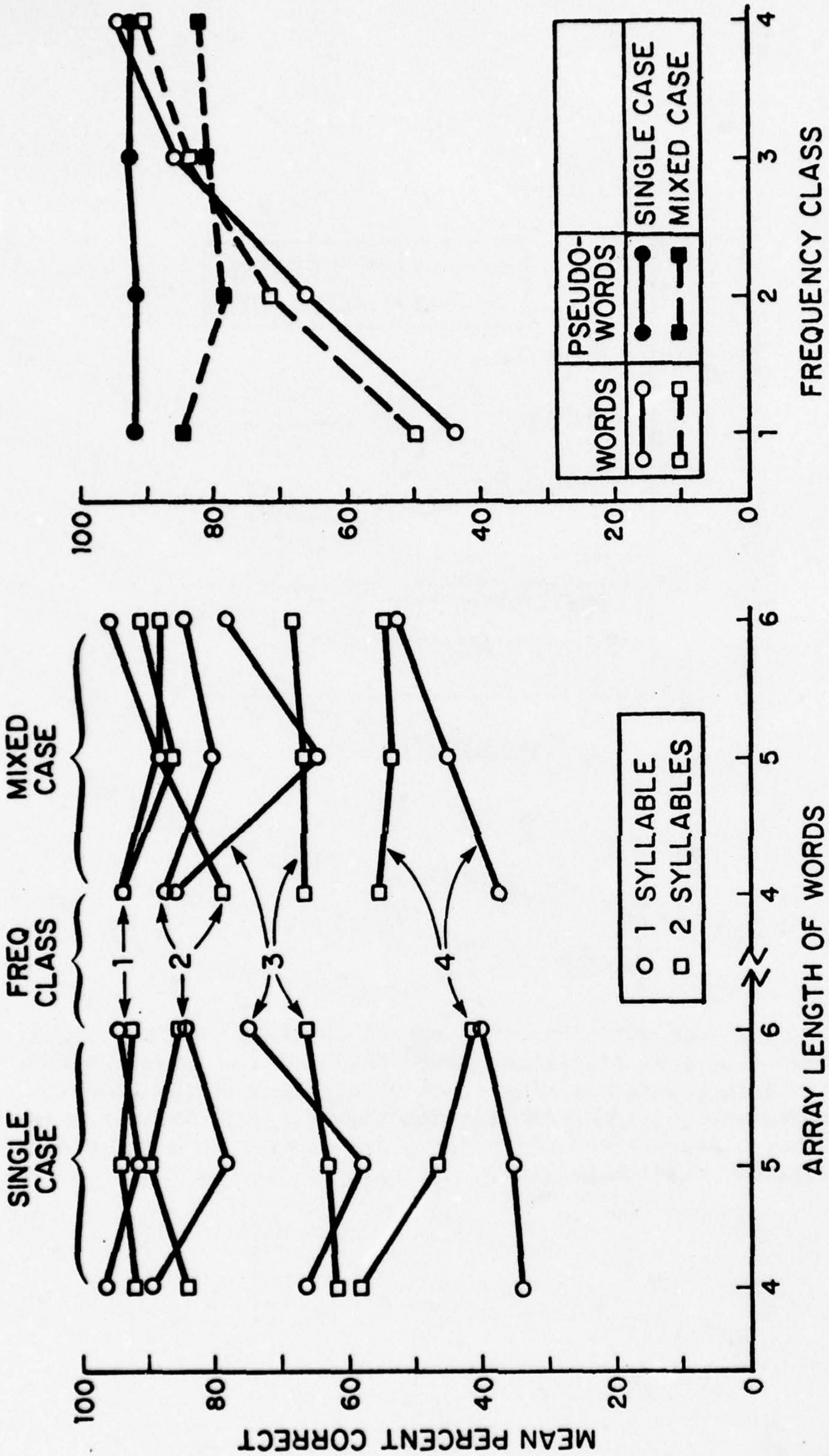

Fig. 13 Percentage of correct lexical decisions for words varying in length, number of syllables, and frequency class (shown on the left), and for pseudowords and words varying in frequency class (shown on the right).

pseudowords (82% correct compared with 93% correct for good readers).

In summary, the strong effects of case mixing on reaction times and errors in making lexical decisions demonstrate that the visual familiarity and integrity of multiletter units is essential to the process of word recognition. The interaction between array-length and visual familiarity supports the conclusion that decoding processes--dependent as they are on the number of units to be decoded--proceed at a slower pace when the units to be decoded are individual letters. On the other hand, the minimal influence of case mixing on the magnitude of syllable effects suggests that syllabication and stress assignment occur after a phonemic representation has been built which is independent of the visual familiarity of the stimulus. Poor readers were found to be particularly susceptible to stimulus manipulations that increase demands placed on the decoding system--in the present case, by reducing visual familiarity. This deficiency in decoding ability may be due to an imperfect mastering of rules for phonic analysis, to deficits in more basic processing subsystems (e.g., immediate memory) which are utilized in decoding, or to both of these sources. That subjects of varying reading ability do not differ in times for retrieving low and high frequency words that are visually familiar suggests that their skill deficiencies may be localized at the perceptual and decoding levels; however, the effect of case mixing on word

frequency effects for poor readers shows that times for lexical retrieval can be elevated if the stimulus representation used in accessing the lexicon is of uncertain accuracy and quality.

III. CONCLUSIONS

We have demonstrated that there are striking differences among readers in perceptual and decoding skills, and in their use of such skills in making lexical identifications. We have not, however, so far found any substantial differences among readers in times for lexical retrieval beyond those that are attributable to skill differences at the perceptual and decoding levels. Differences among readers at the lexical level are those dealing with variations in the extent of vocabulary.

The question can be asked, why do readers who differ in skills at the perceptual and decoding levels also differ in their ability to comprehend written discourse, as required in the Nelson-Denny Reading Test. Two possibilities come to mind:

1. Processing Capacity and Automaticity of Decoding. Perfetti and Hogaboam (1975) have suggested that decoding and phrase-level processes compete for limited processing resources. Thus, a reader who must constantly shift his attention from phrase-level processing (e.g., building semantic representations, drawing inferences, solving problems of reference, etc.) to individual word decoding will have greater difficulty in comprehension of a text than will a reader who decodes swiftly and automatically, and who can concentrate processing resources on the problem of text understanding.

2. <u>Covariance of Skill Deficienceis across Levels of Processing</u>. Another possibility is that, due to educational and cultural factors, readers who differ in perceptual and decoding skills are also likely to differ in higher-level skills involved in understanding text. These phrase-level skills, apart from the conditions under which they are learned, may be functionally independent of lower-level decoding skills. If this is the case, tests of reading comprehension that have been matched to a reader's level of proficiency in decoding should continue to show reliable differences in readers' responses to comprehension items. Whatever the resolution of this issue, I feel on the basis of our results that it is feasible to measure differences among subjects in processing efficiency and accuracy within specified domains, through the use of experimental methods of analysis. Hopefully, the results of this effort will provide measures that can be used to evaluate the effects of instruction and to suggest alternative strategies for improving reading ability.

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